

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

NUTRIENT MANAGEMENT

(Acre)
CODE 590

DEFINITION

Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

PURPOSES

- ◆ To budget nutrients for plant production.
- ◆ To properly utilize manure or organic by-products as a plant nutrient source.
- ◆ To minimize the delivery of agricultural nutrients to surface and ground water resources.
- ◆ To protect air quality by reducing nitrogen and/or particulate emissions to the atmosphere.
- ◆ To maintain or improve the physical, chemical, and biological condition of the soil.

Realistic yield expectations (RYEs) have been established for common North Carolina crops, based on soil productivity information, yield data, and research with North Carolina soils, and cropping systems. Planned nitrogen application rates may be based on either these established yield goals, or documented actual yield data from the site. To identify an RYE based on actual yield data, determine the average of the highest three yields of the last five consecutive specific crop harvests. For forage crops, determine the average of the highest three years of the last five years.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

If no yield data or established RYE values exist for a crop, a nitrogen fertilization rate recommended by North Carolina State University may be used. In the absence of this recommendation, or until documented yield information has been collected, the nutrient management planner may infer a realistic yield from a similar crop on a soil with similar physical and chemical features. The same procedure applies when establishing an RYE for a new crop. The nutrient management plan should document the source of the RYE.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with applicable Federal, state, and local laws and regulations.

Nutrient management practices that are components of a comprehensive conservation plan shall be compatible with the plan's other requirements.

Plans for nutrient management shall specify the source, amount, timing and method of application of nutrients on each field to achieve realistic production goals, while minimizing nitrogen or phosphorus movement to surface or ground waters.

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive nutrients.

Soil Sampling and Laboratory Analysis (Testing)

Nutrient management plans shall be developed based on current soil test results. Current soil tests are those that are no older than three years.

Soil samples shall be collected and prepared in accordance with North Carolina State University or the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Agronomic Division standards or recommendations.

Soil test analyses can be performed by any laboratory or program that is certified by the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Water Quality, Laboratory Section.

NCDA&CS Agronomic Division uses the Mehlich-3 extractant process for soil testing. Growers who utilize other laboratories must request the use of the Mehlich-3 methodology to ensure the test results are compatible with North Carolina's nutrient management planning and assessment tools. All laboratories used must provide fertilization recommendations using guidelines and methodologies similar to those used by the NCDACS Agronomic Division. Growers are encouraged to use a laboratory that is supported by field research within the state.

Soil testing shall include analysis for all nutrients for which specific information is needed to develop the nutrient plan.

Plant Tissue Testing

Tissue sampling and testing, when used, shall be done in accordance with North Carolina State University or NCDA&CS standards or recommendations.

Nutrient Application Rates

Recommended nutrient application rates shall be based on North Carolina State University or NCDA&CS recommendations that consider current soil test results, RYEs, and management capabilities.

Liming material shall be applied as needed to adjust soil pH to the specific range required by the crop or crops in the rotation for optimum availability and utilization of nutrients.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following:

- ◆ **Nitrogen Application** - Planned nitrogen application rates shall match, as closely as possible, the recommended rates using the RYE for the site. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.
- ◆ **Phosphorus Application** - Planned phosphorus application rates shall match the soil test recommended rates as closely as possible. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.
- ◆ **Potassium Application** – Planned potassium application rates should match the soil test recommended rates as closely as possible. This is particularly critical in situations where a potentially harmful nutrient imbalance in crops or forages may occur (e.g. hypomagnesia, also known as grass tetany). When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.
- ◆ **Other Plant Nutrients** - The planned rates of application of other nutrients shall be consistent with North Carolina State University or the NCDA&CS guidelines or recommendations.
- ◆ **Starter Fertilizers** - Starter fertilizers containing nitrogen, phosphorus and potassium may be applied in accordance with North Carolina State University or the NCDA&CS guidelines or recommendations. When starter fertilizers are used, they shall be included in the nutrient budget.

Nitrogen, phosphorus, or potassium may exceed recommended rates only when custom blended commercial fertilizers are not

available, or when animal manure or other by-products are used as a nutrient source (see additional criteria applicable manure application). Several sources of varying analysis fixed-ratio fertilizers should be used whenever possible to match the specified application rate as closely as possible. This provision exists to facilitate the practical application of this standard on a periodic basis. Exceeding the recommended nutrient rates (from soil test/RYE) using inorganic fertilizer on a long-term or continuous basis is not acceptable.

Nutrient Application Timing

Timing of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, and field accessibility. Nutrients shall not be applied to frozen, snow-covered, or saturated soil.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449). Application equipment should be properly calibrated to ensure uniform distribution of material at planned rates.

Plan Review and Revision Period

A thorough review and revision (if needed) of the nutrient management plan shall be conducted on a regular cycle, not to exceed five years.

Nutrient Management Plan Development

The acceptable values for use in nutrient management planning for RYEs, nitrogen factors, phosphorus removal rates, and default nutrient values for animal waste, are those that have been approved by the N.C. Interagency Nutrient Management Committee, and may be found at:

www.soil.ncsu.edu/nmp

Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source

When developing the nutrient management plan, nutrient values of manure and organic by-products (excluding sewage sludge) shall be established based on laboratory analysis, acceptable default values, or historic records for the operation. Acceptable default values are recognized by NRCS as those referenced in the Waste Utilization Standard (Code 633), Field Office Technical Guide. For livestock classes not referenced in 633 Standard, planners should use values from the USDA Agricultural Waste Management Field Handbook, Chapter 4 - Agricultural Waste Characteristics.

When determining actual application rates, a laboratory analysis is the preferred method to determine nutrient values of the manure and organic by-product to be applied, and is required by state laws or rules for regulated operations. Acceptable laboratories include the NCDA&CS Agronomic Division, or others certified by the NCDENR.

Field Risk Assessment

When animal manure or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport from the field shall be conducted. The North Carolina Phosphorus Loss Assessment Tool (PLAT) shall be used to complete this assessment, and the results discussed with the producer. The nutrient management plan shall include:

- ◆ a record of the PLAT assessment rating for each field or sub-field, and
- ◆ information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

PLAT will assess the potential for phosphorus (P) to be transported from the field or sub-field to surface water through each of the four primary loss pathways:

- ◆ sediment-bound P transported through erosion,

- ♦ soluble P transported through surface runoff,
- ♦ soluble P leached through the soil profile, and
- ♦ non-incorporated source P transported through surface runoff.

Based on the assessment of each loss pathway, PLAT will produce a single rating for each site. As shown below, this rating will identify whether nitrogen or phosphorus shall be the rate-determining element in developing the planned application rate for manure.

PLAT Rating	Nutrient Application Criteria
LOW	Nitrogen-based manure application.
MEDIUM	Nitrogen-based manure application.
HIGH	Manure application limited to phosphorus removal from site in harvested plant biomass.
VERY HIGH	No additional manure application to be specified in plan for the site.

On all sites, regardless of the PLAT rating, starter fertilizers may be recommended in accordance with NCSU guidelines or recommendations.

Using the PLAT results as a guide, management strategies and supporting conservation practices should be planned and applied to reduce the potential for excessive phosphorus loss to surface water. In some cases, the PLAT rating can be changed for a site by modifying the factors that affect the potential for loss. Examples include:

- planning buffers or filter strips to reduce sediment-bound phosphorus delivery,
- planning residue management to reduce runoff and soluble phosphorus delivery,
- applying erosion control practices to reduce sediment delivery,
- limiting manure application to selected portions of fields that are flatter, less erosive, or further from surface water,

- improving pasture stand condition to reduce runoff of soluble phosphorus, or modifying the amount and application method of manure.

Nutrient Application Rates

The application amount and rate (in/hr) for material applied through irrigation shall not result in runoff from the site. The application shall not exceed the field capacity of the soil. The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following guidance:

- ♦ **Nitrogen Application** - When the plan is nitrogen-based (a PLAT rating of Low or Medium), the application rate of manure or organic by-products shall be based on the recommended nitrogen rate using the RYE for the site (or a rate recommended by NCSU or NCDA in the case of crops without established RYEs). This may result in an application rate for other nutrients that exceeds the soil test recommendation.

When the plan is being implemented on a phosphorus standard (a PLAT rating of High or Very High), manure or other organic by-products shall be applied at rates consistent with the phosphorus application guidance below. In such situations, an additional nitrogen application from non-organic sources may be required to supply nitrogen at the rate recommended by the RYE.

Within the limits allowed by PLAT, manure or other organic by-products may be applied on soybeans at rates equal to the estimated removal of nitrogen in harvested plant biomass.

All nitrogen rates for hay production are for pure grass stands. Due to the nutrient recycling by grazing animals, the planned nitrogen rate per unit yield for hay crops shall be reduced by 25% for the portion of the expected yield that is removed through grazing.

- ♦ **Phosphorus Application** – When manure or other organic by-products are used, the planned rates of phosphorus

application shall be based on the PLAT rating for the site, as follows:

Low or Medium Rating – The planned manure or organic by-product application rate is based on the nitrogen needs of the crop.

High Rating – The planned manure or organic by-product application rate is limited to the phosphorus removal rate of the harvested plant biomass.

Very High Rating – No additional manure or organic by-product application is specified in the plan.

On all sites, regardless of the PLAT rating, starter fertilizers containing nitrogen, phosphorus, and potassium may be recommended in accordance with North Carolina State University guidelines or recommendations.

A single application of phosphorus applied as manure or organic by-product may be made at a rate equal to the recommended phosphorus application or estimated phosphorus removal in harvested plant biomass for the crop rotation or multiple years in the crop sequence.

- ◆ When such single applications are made, the rate shall:
 - not exceed the recommended nitrogen application rate during the year of application, or
 - not exceed the estimated nitrogen removal in harvested plant bio-mass during the year of application when there is no recommended nitrogen application, or
 - not be made on sites with a Very High PLAT risk rating.

Nutrient Application Timing and Methods

Manure or organic by-products shall not be applied more than 30 days prior to planting of the crop or forages breaking dormancy. Manure shall be applied in accordance with criteria contained in the Waste Utilization Standard (Code 633).

Heavy Metals Monitoring

When sewage sludge is applied, the accumulation of potential pollutants (including arsenic,

cadmium, copper, lead, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and applicable state and local laws or regulations. Additional information on heavy metal criteria for sewage sludge may be found at:

<http://www.epa.gov/reg5oh2o/npdestek/npdpptg6.htm>

For all animal manure or organic by-product application sites, zinc and copper concentrations shall be monitored and alternative crop sites for application shall be sought when these metals approach excessive concentrations.

The following criteria and actions are provided:

ZINC	
Mehlich-3 Index (Zn-I)	Action
300 (21 lbs/ac)	Peanuts are very sensitive to zinc, and application on peanuts should be limited. Seek alternative sites when possible. The risk of zinc toxicity is greater with low soil pH and has been seen at Zn-I as low as 300. *
500 (35 lbs/ac)	Critical toxic level for peanuts. Cease application on peanuts. *
2,000 (142 lbs/ac)	Caution: Seek alternative sites when possible for all crops. *
3,000 (213 lbs/ac)	Critical toxic level for all crops. Cease application for all crops. *
COPPER	
Mehlich-3 Index (Cu-I)	Action
2,000 (72 lbs/ac)	Caution: Seek alternative sites when possible for all crops. *
3,000 (108 lbs/ac)	Critical toxic level for all crops. Cease application on all crops. *
* Maintain pH at 6.0 on these sites.	

Additional Criteria to Minimize the Delivery of Agricultural Nutrients to Surface and Ground Water Resources

In areas that have been identified as impaired with agricultural nutrients being a likely source, an assessment shall be completed of the potential for nitrogen or phosphorus transport from the site, even when no manure or organic by-products are being applied. The streams / water bodies in this category are listed in the USDA-NRCS Field Office Technical Guide, Section I.

The assessment tools to be used in North Carolina are the Leaching Index for Soluble Nutrients (LI) and/or the Phosphorus Loss Assessment Tool (PLAT), and may be found in the USDA-NRCS Field Office Technical Guide Section III. In these instances, PLAT shall only be used when the existing soil test phosphorus index (P-I) is at a level of High or Very High and no crop response is expected for the planned crop from the additional application of phosphorus. Similarly, the LI shall only be used when the site conditions indicate the potential for leaching of nutrients.

The results of these assessments, when required, shall be discussed with the producer and included in the nutrient management plan. Regardless of the results from these assessments, the nutrient application rates shall be based on RYE rates for nitrogen and soil test recommendations for phosphorus. Conservation plans developed to minimize the delivery of agricultural nutrients to surface and groundwater resources shall include appropriate practices to reduce the risk of nutrient movement from the field.

Additional Criteria to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere

Incorporate surface applications of solid forms of manure or some commercial fertilizer nitrogen formulations (i.e. Urea) into the soil within 24 hours of application.

When applying liquid forms of manure with irrigation equipment, select application conditions when there is high humidity,

little/no wind blowing, a forth-coming rainfall event, and/or other conditions that will minimize volatilization losses into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan.

Handle and apply poultry litter or other dry types of animal manures when weather conditions are calm and there is less potential for blowing and emission of particulates into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties, or biological condition.

Nutrients shall not be applied to saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

Consider induced nutrient imbalances due to excessive levels of fertilizer application.

Consider complementing or enhancing nutrient management by relieving moisture stress in crops by using practices that promote infiltration or reduce evaporation and those that intercept surface runoff.

Some supporting practices to consider when developing the nutrient management plan include:

Practices that Promote Infiltration or Reduce Evaporation

- Chiseling and Subsoiling (324)
- Conservation Crop Rotation (328)
- Contour Farming (330)
- Cover Crop (340)
- Irrigation Water Management (449)
- Land Smoothing (466)
- Long Term No-Till (778)
- Precision Land Forming (462)
- Residue Management, No-Till & Strip Till (329A)
- Residue Management, Seasonal (344)

- Stripcropping, Contour (585)
- Stripcropping, Field (586)
- Water Table Control (641)
- Windbreak/Shelterbelt Establishment (380)

Practices that Intercept Surface Runoff or Shallow Ground Water

- Conservation Cover (327)
- Constructed Wetland (656)
- Controlled Drainage (335)
- Field Border (386)
- Filter Strip (393)
- Grassed Waterway (412)
- Hedgerow Planting (422)
- Pond (378)
- Riparian Herbaceous Cover (390)
- Riparian Forest Buffer (391)
- Sediment Basin (350)
- Structure For Water Control (587)
- Water And Sediment Control Basin (638)
- Wetland Restoration (657)

Practices that Promote Better Moisture Distribution and Nutrient Use on Grassland

- Grazing Land Mechanical Treatment (548)
- Prescribed Grazing (528)
- Forage Harvest Management (511)

Consider cover crops whenever possible to scavenge and recycle residual nitrogen.

Consider alternative application methods and timing that further reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

- ◆ split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- ◆ band applications of phosphorus near the seed row,
- ◆ applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques,
- ◆ immediate incorporation of land applied manure or organic by-products,
- ◆ delaying field application of fertilizer, animal manure or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider for all soil amendments, minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manure or organic by-products, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manure. Volatilization losses can become significant, if manure is not immediately incorporated into the soil after application.

Consider the potential to affect National Register listed or eligible cultural resources.

Consider using soil test information no older than one year when developing new plans, particularly if animal manure is to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

Consider soil sampling by depth to determine feasibility of diluting a high phosphorus level in the soil surface with precise plowing. (Caution: While this practice may lower the soil test phosphorus in the surface and reduce the potential for soluble phosphorus losses in surface runoff, it may also increase particulate phosphorus losses through soil erosion. Impacts on highly erodible land compliance plans should also be considered.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content, and enhance the producer's ability to manage manure effectively.

Consider amending poultry litter with alum since it is recognized as an economical means of reducing ammonia volatilization in the poultry house and soluble phosphorus in runoff waters.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals, and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan or nutrient management/waste utilization plan:

1. aerial photograph or map and a soil map of the site identifying areas of planned nutrient application,
2. planned plant production sequence or crop rotation,
3. results of soil, plant, water, manure or organic by-product sample analyses,
4. results of PLAT and LI assessments (if required),
5. RYEs for the crops in the rotation and the source of information if other than default values,
6. quantity of all nutrient sources planned,
7. recommended nutrient rates, timing, and method of application and incorporation,
8. location of designated sensitive areas or resources (e.g. streams, wells, sinkholes, etc.) and the associated nutrient management restriction, if present in the conservation management unit,
9. operation and maintenance information, and
10. complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- a. that the planned nutrient application level is not sustainable, and that eventually, a High rating with the Phosphorus Loss Assessment Tool will result based on this field's specific soil loss rate, runoff

amount, leaching loss, and animal waste source (if applicable),

- b. the relationship between soil phosphorus levels and potential for phosphorus transport from the field (as reported by the PLAT assessment), and
- c. the potential for cumulative soil phosphorus removal from the production and harvesting of crops (as reported in the North Carolina Nutrient Management Software). For more information on crop removal rates, see the website:

www.soil.ncsu.edu/nmp

When applicable, the conservation plan for the site shall include other practices or management activities as required by specific laws or regulations (e.g. .0200 regulations), program requirements, or producer goals.

In addition to the requirements described above, plans for nutrient management shall also include a copy of either the NRCS Nutrient Management Job Sheet, the NRCS Nutrient Management/Waste Utilization Job Sheet (if manure is applied), or comparable information that contains:

- a. a discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow groundwater and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies. The basis for this information is found in the results of the Phosphorus Loss Assessment Tool or Leaching Index analysis.
- b. a discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.

- c. a statement that the plan was developed based on the requirements of the current standard and any applicable Federal, state, or local regulations or policies; and
- d. that a change in any of these requirements may necessitate a revision of the plan.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice, including all equipment. Operation and maintenance information is included in the USDA-NRCS Nutrient Management Job Sheet. Operation and maintenance guidance provided to the client must address the following:

1. The producer is encouraged to review the plan annually to determine if adjustments or modifications to the plan are needed. (The S.B. 1217 interagency group guidelines accepted by the N.C. Division of Water Quality for .0200 operations specify a plan revision when there are changes in crops or cropping patterns that utilize more than 25 percent of the nitrogen generated by the operation.) As a minimum, nutrient management plans shall be thoroughly reviewed every five years and revised if necessary.
2. Protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
3. Proper calibration of application equipment to ensure uniform distribution of material at planned rates.
4. Maintaining records to document plan implementation. Records should be maintained for five years, or for a period as required by other Federal, state, or local ordinances, or program or contract requirements. To ensure adequate information exists to support sound nutrient management, NRCS recommends the following records be included:
 - Soil test results and recommendations for nutrient application,
 - Quantities, analyses and sources of nutrients applied (When the actual rates used differ from or exceed the recommended and planned rates on inorganic fertilizer plans, records should indicate the reasons for the differences, e.g. inability to acquire custom blended fertilizer.)
 - Dates and method of nutrient applications,
 - Crops planted, planting and harvest dates, yields, and crop residues removed,
 - Results of water, plant, and organic by-product analyses, and
 - Dates of review and person performing the review, and recommendations that resulted from the review.
5. State laws or regulations may define record-keeping requirements for some operations.
6. Workers should be protected from and avoid unnecessary contact with inorganic fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.
7. The disposal of material generated by the cleaning of nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff or leaching.
8. The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.